I. AMENDMENTS

Amendments to the Specification

Please amend the Specification as follows:

Please amend the paragraph on page 1, line 9 as follows:

This invention relates to a ~~miniaturised~~miniaturized relay. The invention also refers to different uses for ~~miniaturised~~miniaturized relays according to the invention.

Please amend the paragraph on page 1, line 15 as follows:

Currently there are various alternatives for the production of ~~miniaturised~~miniaturized relays, in particular, in the context of technologies known as MEMS technology (micro electro-mechanical systems), Microsystems and/or Mircomachines. In principal such may be classified according to the type of force or actuation mechanism they use to move the contact electrode. The classification usually applied is thus between electrostatic magnetic, thermal and piezoelectric relays. Each one has its advantages and its drawbacks. However ~~miniaturisation~~ miniaturization techniques require the use of activation voltages and surfaces which are as small as possible. Relays known in the state of the art have several problems impeding their advance in this respect.

Please amend the paragraph beginning on page 1, line 26 and ending on page 2, line 4 as follows:

A manner of reducing the activation voltage is precisely to increase the relay surface areas, which renders ~~miniaturisation~~miniaturization difficult, apart from being conducive to the appearance of deformations reducing the useful life and reliability of the relay. In electrostatic relays, another solution for decreasing the activation voltage is to greatly reduce the space between the electrodes, or use very thin electrodes or special materials, so that the mechanical recovery force is very low. However this implies problems of sticking, since capillary forces are very high, which thus also reduces the useful working life and reliability of these relays. The use of high activation voltages also has negative effects such as ~~ionisation~~ionization of the components, accelerated wearing due to strong mechanical solicitation and the electric noise which the relay generates.

Please amend the paragraph on page 3, line 1 as follows:

An~~The~~ objective of the present invention is to overcome the abovementioned drawbacks. This is achieved by means of a ~~miniaturised~~miniaturized relay ~~characterised~~characterized in that

it ~~comprises~~includes:

- a first zone facing a second zone,
- a first condenser plate,
- a second condenser plate arranged in the second zone, in which the second plate is smaller than or equal to the first plate,
- an intermediate space arranged between the first zone and the second zone,
- a conductive element arranged in the intermediate space, the conductive element being mechanically independent of the first zone and the second zone and being suitable for performing a movement across the intermediate space dependant on voltages present in the first and second condenser plates,
- a first contact point of an electric circuit, a second contact point of the electric circuit, in which the first and second contact point define first stops, in which the conductive element is suitable for entering into contact with the first stops and in which the conductive element closes the electric circuit when in contact with the first stops.

Please amend the paragraph on page 6, line 7 and ending on page 8, line 2 as follows:

Another preferable embodiment of the invention is achieved when the relay additionally ~~comprises~~includes a third condenser plate arranged in said second zone and a fourth condenser plate arranged in said first zone, in which said first condenser plate and said second condenser plate are equal to each other and said third condenser plate and said fourth condenser plate are equal to one another. In fact, in this manner, if one wishes the conductive element to travel towards the second zone, one can apply voltage to the first and fourth condenser plates, on one side, and to the second or to the third condenser plates, on the other side. Given that the conductive element will move toward the place in which is located the smallest condenser plate, it will move toward the second zone. Likewise one can obtain movement of the conductive element toward the first zone by applying a voltage to the second and third condenser plates and to the first or the fourth condenser plates. The advantage of this solution, over the simpler three condenser plate solution, is that it is totally symmetrical, which is to say that it achieves exactly the same relay ~~behaviour~~ behavior irrespective of whether the conductive element moves toward the second zone or the first zone. Advantageously the first, second third and fourth condenser plates are all equal with respect to one another, since generally it is convenient that in its design the relay by symmetrical in several respects. On one hand there is symmetry between the first and second zone, as commented above. On the other hand it is necessary to retain other types of symmetry to avoid other problems, such as for example the problems of rotation or swinging

in the conductive element and which will be commented upon below. In this respect it is particularly advantageous that the relay ~~comprise~~include, additionally, a fifth condenser plate arranged in the first zone and a sixth condenser plate arranged in the second zone, in which the fifth condenser plate and the sixth condenser plate are equal to each other. On one hand increasing the number of condenser plates has the advantage of better compensating manufacturing variations. On the other, the several different plates can be activated independently, both from the point of view of voltage applied as of activation time. The six condenser plates can all be equal to each other, or alternatively the three plates of a same side can have different sizes with respect to one another. This allows ~~minimising~~minimizing activation voltages. A relay which has three or more condenser plates in each zone allows the following objectives to all be achieved:

- it can function in both direction symmetrically,
- it has a design which allows a minimum activation voltage for fixed overall relay dimensions, since by having two plates active in one zone and one plate active in the other zone distinct surface areas can always be provided,
- it allows ~~minimisation~~minimization of current and power consumption, and also a smoother relay functioning,
- it can guarantee the opening and closing of the relay, independently of the voltage transmitted by the external circuit to the conductive element when they enter in contact,
- in particular if the relay has six condenser plates in each zone, it can in addition comply with the requirement of central symmetry which, as we shall see below, is another significant advantage. Therefore another preferable embodiment of the invention is obtained when the relay ~~comprises~~includes six condenser plates arranged in the first zone and six condenser plates arranged in the second zone. However it is not absolutely necessary to have six condenser plates in each zone to achieve central symmetry: it is possible to achieve it as well, for example, with three condenser plates in each zone, although in this case one must forego ~~minimising~~minimizing current and power consumption and ~~optimising~~optimizing the "smooth" functioning of the relay. In general, increasing the number of condenser plates in each zone allows greater flexibility and versatility in the design, whilst it allows a reduction of the variations inherent in manufacture, since the manufacturing variation of each of the plates will tend to be compensated by the variations of the remaining plates.

Please amend the paragraph on page 8, line 9 as follows:

Advantageously the relay ~~comprises~~includes a second stop (or as many second stops as

there are first stops) between the first zone and the conductive element. In this manner one also achieves a geometric symmetry between the first zone and the second zone. When the conductive element moves toward the second zone, it can do so until entering into contact with the first stops, and will close the external electric circuit. When the conductive element moves toward the first zone it can do so until entering into contact with the second stop(s). In this manner the movement performed by the conductive element is symmetrical.

Please amend the paragraph on page 8, line 18 as follows:

Another preferable embodiment of the invention is achieved when the relay ~~comprises~~includes a third contact point arranged between the first zone and the conductive element, in which the third contact point defines a second stop, such that the conductive element closes a second electric circuit when in contact with the second contact point and third contact point. In this case the relay acts as a commuter, alternately connecting the second contact point with the first contact point and with the third contact point.

Please amend the paragraph on page 8, line 26 and ending on page 9, line 14 as follows:

A particularly advantageous embodiment of the previous example is achieved when the conductive element ~~comprises~~includes a hollow cylindrical part which defines an axis, in the interior of which is housed the second contact point, and a flat part which protrudes from one side of the radially hollow cylindrical part and which extends in the direction of the axis, in which the flat part has a height, measured in the direction of the axis, which is less than the height of the cylindrical part, measured in the direction of the axis. This specific case complies simultaneously with the circumstance that the conductive element perform a rotational movement around one of its ends (cf. the "second possibility" cited above). Additionally, the cylindrical part is that which rests on bearing surfaces (one at each end of the cylinder, and which extends between the first zone and the second zone) whilst the flat part is cantilevered with respect to the cylindrical part since it has a lesser height. Thus the flat part is not in contact with walls or fixed surfaces (except the first and third contact point) and, in this manner, the sticking and frictional forces are lessened. As to the second point of contact, it is housed in the internal part of the cylindrical part, and serves as rotational axis as well as second contact point. Thus an electric connection is established between the first and second contact points or between the third and second contact points. The hollow cylindrical part defines a cylindrical

hollow, which in all cases has a surface curved to the second contact point, thus reducing the risks of sticking and frictional forces.

Please amend the paragraph on page 9, line 15 and ending on page 10, line 3 as follows:

Another particularly advantageous embodiment of the previous example is obtained when the conductive element ~~comprises~~includes a hollow parallelepipedic part which defines an axis, in the interior of which is housed the second contact point, and a flat part which protrudes from one side of the radially hollow parallelepipedic part and which extends in the direction of the axis, in which the flat part has a height, measured in the direction of the axis, which is less than the height of the parallelepipedic part, measured in the direction of the axis. In fact, it is an embodiment similar to that above, in which the parallelepipedic part defines a parallelepipedic hollow. This solution can be particularly advantageous in the case of very small embodiments, since in this case the resolution capacity of the manufacturing process (in particular in the case of the photolithographc procedures) obliges the use of straight lines. In both cases it should be ~~emphasised~~emphasized that the determining geometry is the geometry of the interior hollow and that, in fact, several different combinations are possible:

- axis (second contact point) having a rectangular section and hollow with rectangular section,
- axis having a circular section and hollow having a circular section,
- axis having a circular section and hollow having a rectangular section and vice versa,

although the first two combinations are the most advantageous.

Please amend the paragraph on page 10, line 15 as follows:

Another preferable embodiment of the invention is obtained when the relay ~~comprises~~includes ~~a~~ third and ~~a~~ fourth contact points arranged between the first zone and the conductive element, in which the third and fourth contact points define second stops, such that the conductive element closes a second electric circuit when in contact with the third and fourth contact points. In fact, in this case the relay can alternatively connect two electric circuits.

Please amend the paragraph on page 10, line 22 and ending on page 11, line 3 as follows:

Advantageously each of the assemblies of condenser plates arranged in each of the first zone and second zone is centrally symmetrical with respect to a ~~centre~~center of symmetry, in

which said ~~centre~~center of symmetry is superposed to the ~~centre~~center of masses of the conductive element. In fact, each assembly of the condenser plates arranged in each of the zones generates a field of forces on the conductive element. If the force resulting from this field of forces has a non nil moment with respect to the ~~centre~~center of masses of the conductive element, the conductive element will not only undergo travel but will also undergo rotation around its ~~centre~~center of masses. In this respect it is suitable to provide that the assemblies of plates of each zone have central symmetry in the case that this rotation is not advantageous, or on the other hand it could be convenient to provide central asymmetry should it be advantageous to induce rotation in the conductive element with respect to its ~~centre~~center of masses, for example to overcome frictional forces and/or sticking.

Please amend page 11, line 14 as follows:

To avoid sticking and high frictional forces it is advantageous that the conductive element have rounded external surfaces, preferably that it be cylindrical or spherical. The spherical solution ~~minimises~~minimizes the frictional forces and sticking in all directions, whilst the cylindrical solution, with the bases of the cylinder facing the first and second zone allow reduced frictional forces to be achieved with respect to the lateral walls whilst having large surfaces facing the condenser plates – efficient as concerns generation of electrostatic forces. This second solution also has larger contact surfaces with the contact points, diminishing the electric resistance which is introduced in the commuted electric circuit.

Please amend the paragraph on page 12, line 16 and ending on page 13, line 15 of the specification as follows:

The subject of the invention likewise relates to preferential uses for relays according to the invention. Apart from use as electric switch and as electric commuter, the relay according to the invention can be used as a sensor for different physical magnitudes. In such cases, the physical magnitude which one wishes to measure exerts a force to open the electric circuit and by means of a given voltage applied to the condenser plates a force is generated which counteracts the former and the external electric circuit is again closed (or vice versa, i.e., it is necessary to apply a voltage to maintain the electric circuit open whilst the physical magnitude which one wishes to study tends to close the circuit). The determination of the voltage required allows determination of the physical magnitude one wishes to measure. In general ~~miniaturisation~~miniaturization allows the inclusion of several sensors simultaneously, which increases the reliability of the corresponding determination. The increase in reliability is due to

the possibility that these different sensors measure the same magnitude, and subsequently one calculates the mean. A particularly advantageous alternative is obtained by arranging a relay according to the invention with electric contacts in both zones, i.e. three or four contacts in total, since in this case one can measure the physical magnitude under study for the time lapsed between interruption of the contact with the electric contact(s) in one zone and the establishment of the electric contact with the electric contact(s) of the other zone, at constant voltage (or even varying the voltage as a further parameter to be accounted for). Below are provided various specific examples:

Accelerometer: the force due to outside acceleration moves the conductive element, opening the electric circuit. The voltage applied to the condenser plates creases an opposing force. When the circuit again closes the voltage required can be determined and thus, the acceleration to which the conductive element has been subjected. This can also take place in reverse, such as commented upon above, the outside acceleration being that which tends to close the circuit. ~~Miniaturisation~~Miniaturization allows provision of various sensors, orientated according to the three coordinate axes. Specific examples would be airbags and tiltmeters.

Please amend the paragraph on page 24, line 28 and ending on page 25, line 13 as follows:

The relay shown in figure 11, is designed to be manufactured with polyMUMPS technology. As already mentioned, this technology is known by a person skilled in the art, and is ~~characterised~~characterized by being a surface micromachining with three structural layers and two sacrificial layers. However, conceptually it is similar to the relay shown in figures 9 and 10, although there are some differences. Thus in the relay of figure 11 the first condenser plate 3 is equal to the third condenser plate 11, but is different from the second condenser plate 9 and the fourth condenser plate 5, which are equal to each other and smaller than the former. With respect to the second contact point 17 it has a widening at its upper end which permits retaining the conductive element 7 in the intermediate space 25. The second contact point 17 of figures 9 and 10 also can be provided with this kind of widening. It is also worth noting that in this relay the distance between the first contact point 15 and the third contact point 21 is equal to the distance between the condenser plates. Given that the movement of the conductive element 7 is a rotational movement around the second contact point 17, the opposite end of the conductive element describes an arc such that it contacts with first or third contact point 15, 21 before the flat part 33 can touch the condenser plates.